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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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ROBOTICS

ECONOMIC EXPERIMENT IN UKRAINIAN MACHINE TOOL INDUSTRY UPDATED

Kiev RADYANS'KA UKRAYINA in Ukrainian 23 Feb 84 p 3

[Article, published under the heading "Economic Experiment in Action," by V. Gayevoy, chief, Machine Building Department, Central Committee of the Communist Party of the Ukraine: "Great Rights, High Responsibility"]

[Text] The fourth year of the five-year plan is under way. Its commencement will unquestionably become a significant landmark in the further development of mass socialist competition. The additional party task specified at the December (1983) CPSU Central Committee Plenum -- to achieve a 1-percent above-target increase in labor productivity plus an additional half a percent decrease in prime cost below target -- evoked in workforces a counterflow of initiative and an innovative, committed search for new reserve potential.

This year's production calendar is marked with still another important event in our country's economic affairs -- a large-scale economic experiment has begun in a number of branches of industry.

In his speech at the special CPSU Central Committee Plenum, CPSU Central Committee General Secretary Comrade K. U. Chernenko stressed: "The system of management of the economy and our entire economic management mechanism require a major overhaul. Work in this area has just begun. It includes a large-scale economic experiment to broaden the authorities and increase the responsibility of enterprises."

As we know, some new elements of management will be tested in the course of the experiment. Their results will become a basis for drafting corresponding proposals for the national economy as a whole.

Both during the period of preparation for the experiment and since the experiment commenced, I visited a number of this republic's machine-building enterprises. It is gratifying that everybody -- from worker to general manager, from rank-and-file Communist to party commiittee secretary -- has adopted an attitude of profound understanding toward work under the new conditions. Everybody is clearly aware that the end objective of the experiment is to speed up transition to intensive methods of economic management, to boost the pace of production, and to improve production qualitative indices.

This is certainly a difficult but entirely realistic task. It has been placed on the agenda by practical realities. Its implementation constitutes a serious test for each and every workforce. The experiment is putting to a practical test the maturity of the economic thinking of cadres and the level of their professional competence, initiative, and enterprise. In other words, what we are dealing with is a further improvement in the art of management, work style, for broadening of the authorities of associations and enterprises of necessity also brings increased responsibility for actual return on effort, for high end results of all economic activity.

Among the five ministries taking part in the experiment, there are two union ministries -- the Ministry of Heavy and Transport Machine Building, and the Ministry of Electrical Equipment Industry. In our republic these two branches are represented by 95 enterprises and associations, and 57 scientific research, design and engineering organizations. They involve a labor force of 385,000 workers, including 53,500 Communists. The following figures indicate the scale of the activities of these workforces. The heavy and transport machine building enterprises located in this republic produce more than one third, and electrical equipment industry enterprises -- almost one fifth of the total output of these ministries. Developing within the unified national economic complex of the Soviet Union and strengthening partnership with the workforces of the brother republics, the machine builders of the Ukraine turn out 97 percent of this country's main-line diesel locomotive production, more than 52 percent of main-line freight cars, 85 percent of coking, 65 percent of blast-furnace and steelmaking, and 37 percent of rolling-mill equipment, almost half of all the power transformers, all custom-built ultra-high-power transformers, etc. More than one third of the goods produced by this republic's heavy machine building enterprises and more than half of the goods manufactured by electrical equipment plants and associations carry the Seal of Quality.

All this places heightened responsibility on the party organizations and workforces of enterprises for successful accomplishment of the economic experiment, for the brunt of the task is being shifted precisely to the workforces. And from the very first days of working under the new conditions they have become involved in an aggressive search for deep-lying production reserve capacity, motivated by genuine economic incentive.

Our industry's vanguard workforces are acting as fine pacesetters in this endeavor -- the Novokramatorskiy Machine Building Plant Association (general manager Ye. O. Matsehora, party committee secretary M. P. Shapovalov), Zhdanovtyazhmash (I. D. Nahayevs'kyy and V. V. Butyrin), Zaporozhtransformator (L. P. Khadzhinov and M. U. Kotlyuba), Vatra (R. Yu. Yaremchuk and O. S. Revyakin), plus others. A number of them are base units in their branches for conduct of the experiment. Managers, specialists, and the broad body of activists at these enterprises are working purposefully in the new manner.

Obviously a large-scale experiment is a matter not only for a narrow group of professionals. The more people become involved in creative activity, in participation in formulation and successful implementation of tough, economically substantiated plans, the greater will be the return on effort. This demands stepped-up organizational and indoctrination work on the part of party organizations, clarity in publicizing the advantages and potential of the experiment.

In the shops at NKMZ [Novokramatorskiy Machine Building Plant], for example, one can see numerous posters and leaflets, which persuade in a vivid and clear manner, on the basis of specific figures: that which is advantageous to the state is advantageous to the individual -- material reward depends directly and immediately on end results. The local large-circulation newspaper and radio are aggressively assisting.

Tasks pertaining to preparation for and execution of the experiment have been discussed everywhere at party and worker meetings in production subdivisions and at meetings of enterprise party-economic activists. Future activities were clearly delineated. Organizational-technical and mass-political measures specified the strategy and tactics of the labor offensive and accomplishment of qualitatively new tasks pertaining to boosting the efficiency of the economy. Commissions of party committees to monitor management activities pertaining to preparing for and conducting the experiment were formed in large party organizations in the course of reports and elections. The points of the experiment are being studied in a substantive manner in the economics education system. Party organizations are seeking to form a new type of contemporary economic thinking not only on the part of shop superintendents and section chiefs, but also on the part of foremen, brigade leaders, vanguard production workers and production innovators.

And this is producing good results. Workforces adopted counterplans and tougher pledges for 1984. These reflect the new criteria and demands of the present stage. The machine builders of Zhdanov and Kramatorsk, for example, entering competition for one-percent above-target labor productivity and half a percent decrease in product prime cost, precisely specified ways to achieve these goals. They include adoption of advanced know-how, new equipment, and advanced technology.

In his report at the January (1984) Plenum of the Central Committee of the Communist Party of the Ukraine, CPSU Central Committee Politburo member V. V. Shcherbitskiy, first secretary of the Central Committee of the Communist Party of the Ukraine, emphasized: "One of the decisive elements in accomplishing the assigned tasks is efficient utilization of the enormous production potential created in our nation's economy."

Special attention is presently being devoted to qualitative indicators, which embody level of economic management. We are dealing here with such important economic categories as increase in return on capital, equipment shift utilization factor, achievement of projected labor-intensiveness, etc.

Recently the workforces of five leading machine building enterprises in this republic specified ambitious targets pertaining to boosting the equipment shift utilization factor. As we know, they appealed through the newspaper RADYANS'KA UKRAYINA to all our republic's working people to engage in shock-work competition under the slogan "Maximum Return From Every Machine Tool!" It is characteristic that two of these five workforces -- at Zaporozhtransformator and Vatra -- are working in conditions of the economic experiment. Their top workers -- assembler brigade leader V. Nesterenko, deputy to the UkSSR Supreme Soviet, insulator Hero of Socialist Labor N. Lahno, coil winder M. Korol', USSR

State Prize recipient, from Zaporozhtransformator, benchman-toolmaker Hero of Socialist Labor P. Kustra and coil winder brigade leader L. Ryabkov from Vatra, plus thousands of other five-year plan labor watch right-flankers are investing a great deal of productive effort and energy, initiative and skill in order to increase their contribution toward successful accomplishment of the experiment.

It is a well-known fact that the economic experiment is opening up possibilities for efficient activity. Shaping economic, material and moral conditions in which each workforce will endeavor to work more aggressively and precisely meet its contractual obligations, it focuses on the production of high-quality goods with less material and labor outlays. The number of indicators ratified at a higher level is also being reduced.

But how can we realistically reach the specified goal? It is quite understandable that success cannot be achieved without intensive preparatory work. Indicative in regard to this is the activity of the party organization and management of the Lvov Konveyer Production Association. It was not so long ago that it was bringing up the rear, as they say. In preparing for working under the new conditions, however, they revised the product list in a critical manner and taking reserve potential into account. The decision was made substantially to update the product list and to produce models capable of competing in the world market. On the basis of diligent, comprehensive economic analysis, the workforce specified ways to meet five-year-plan targets ahead of schedule. And the very first month of working under the new conditions attested to the fruitfulness of the applied efforts. The association successfully met the January plan targets, including -- and this is particularly important! -- in the area of contractual obligations.

It is gratifying to note that Zhdanovtyazhmash, NKMZ, the Starokramatorskiy Machinery Plant, Kharkov Elektrotyazhmash, plus other large enterprises successfully accomplished January targets, including goods deliveries targets.

The first month of the experiment is completed. It is still premature to reach conclusions. But one thing is sure: it has revealed positive production development trends. Worker initiative and responsibility have increased. There is an aggressive, purposeful effort in progress to find improved forms of management. Organization of work stations and brigade forms of organization of labor is improving.

Under these new conditions the people at the enterprises have begun working in a more substantive way and more deeply with organization of socialist competition among brigades for improving production efficiency. This is exceptionally important, for in the past sometimes efforts were focused on increasing the number of brigades, but there was failure to dig to the heart of the matter. At this republic's electrical equipment enterprises, for example, the number of brigades has increased by almost one third in the current five-year plan. But the number of those working for end result has increased by only 17.5 percent. Even at vanguard associations they have not paid enough attention to establishing excellent-quality brigades. Having analyzed these processes, production workers have now approached the brigade form in a new manner. Today brigades

have greater potential and opportunity for boosting labor productivity and product quality. And this potential is being utilized.

Other critical production tasks are also being more successfully resolved in the course of preparing for the experiment and at commencement of execution. Party organizations are focusing workforces on more rapid assimilation and better utilization of production capacity and improvement of the capital-output ratio. Things are not going smoothly everywhere, however. It has been necessary to intervene in this process. At the Aleksandriya Electrical Machinery Plant in Kirovograd Oblast, for example, considerable production capacity for the manufacture of electrical instrumentation, employing a modern manufacturing process, has been brought on-line in the current five-year plan. Unfortunately, certain enterprises of the Ministry of Ferrous Metallurgy, Ministry of the Chemical Industry, and other branches have failed promptly to arrange for the production of requisite materials. Therefore the plant has been forced to operate at half-capacity. This had already been causing serious concern. Finally, however, the experiment has brought everything to a head. It has become obvious that things cannot continue like this. The Ministry of Electrical Equipment Industry has given considerable assistance to the plant. And results have been produced. The workforce has begun working more confidently, and in January met the plan targets in almost all major industries. A great deal of work still remains to be done, however.

Party committees are approaching the work performance of every enterprise with such elevated criteria. Revealing reserve potential, they are finding ways more rapidly to implement this potential.

One of the important items which are a matter of serious concern to workforces is the level of supply, for every enterprise is bound by contractual obligations to a great many others which are not taking part in the experiment. Unfortunately not all these partners are reliable. They frequently let their partners down. The Kryukovskiy Railcar Plant and the Novaya Kakhovka Electrical Machine Building Plant, for example, find themselves in difficult straits due to only partial allocation of stocks for rolled metal products. Cable plants have been allocated less than their actual requirements in plastic compounds. Unquestionably the system of relations between customers and suppliers requires further improvement. Gossnab and supply agencies should take under particular scrutiny execution of supply plan targets not only at enterprises operating under the experiment but also their suppliers.

The experiment is gathering momentum. It is picking up the pace. Party organizations are faced with the task of intensifying organizational and ideological work directed toward instilling in people a strong sense of responsibility for successful accomplishment of the experiment. There is no doubt whatsoever that workforces will do everything possible to achieve optimal end results and will successfully accomplish the plan targets for this year and the 11th Five-Year Plan as a whole.

3024
CSO: 1811/43

INDUSTRY URGED TO INCREASE OUTPUT OF NC MACHINE TOOL, ROBOTICS

Moscow PRAVDA in Russian 2 Feb 84 p 1

[Article: "The Word of Machine Tool Builders"]

[Text] Guided by the decrees of the 26th party congress and the instructions and recommendations of Comrade Yu. V. Andropov, Secretary General of the CPSU Central Committee and Chairman of the Presidium of the USSR Supreme Soviet, contained in his speech at the December (1983) Plenary Session of the CPSU Central Committee, workers in the sector in a spirit of labor and political enthusiasm, having developed socialist competition for the fulfillment and overfulfillment of planned goals for (1984) and the 11th Five-Year Plan period as a whole, undertake the following obligations.

Raise the productivity of labor one percent above the plan and insure its growth by 6.6 percent in the current year; reduce production costs additionally by a half percent. Complete the annual plan for the volume of production by 28 December 1984 and manufacture additional commercial products in an amount of 36 million rubles, including forge-press equipment for 2 million rubles, metalworking, abrasive and diamond tools for 5 million rubles; general machinebuilding products for 4 million rubles and cultural-personal service goods for 3.6 million rubles. Provide 97 percent of the increase in the volume of production by increasing the productivity of labor. Obtain 5 million rubles of profit above the plan.

Achieve contract obligations on product delivery in established volumes and types of products.

Develop the production of most progressive and high productivity types of equipment at accelerated rates including an increase in the production of machine tools with numerical control by 25 percent and of these, multioperational tools by 41 percent; forge-press machines with numerical control by 89 percent; automatic lines for machinebuilding and metalworking by 24 percent.

Increase the production in 1984 of industrial robots by 22 percent, manufacture not less than 300 robotized machine tool complexes, basically standardized equipment modules. In the Voronezh Forge-Press Production Association master a series of readjustable robotized flow-lines. At the Moscow "Krasnyy proletariy" Plant put into action the first stage of flexible automated

production of industrial robots with programed control. In the Leningrad Machine Tool and Tool Association, produce highly accurate domestically made devices to monitor products and tool wear for the operation of unattended machine tool modules.

Produce 44 prototypes above the plan and 20 series of new types of industrial products, as well as 2 million rubles worth of high productivity tools for "machining center" type machine tools with numerical control. Master the industrial synthesis of large industrial diamonds of high strength and produce 200,000 carats above the plan. Supply technological equipment to enterprises of the agricultural-industrial complex and spare parts of the established types to agriculture ahead of schedule.

To raise further the technical standard and organization of production, introduce in the enterprises of the sector 57 high productivity sections, 80 mechanized flow-line lines, 180 automatic manipulators with programed control and not less than 2000 units of modern equipment, including 940 machine tools with numerical control. Reduce the ratio of workers doing manual labor to 28.5 percent.

By using low-waste technology and efficient utilization of material and power resources save 4000 tons of ferrous metal rolled stock above the plan and 32 million kilowatt hours of electric power; save 84.0 million rubles by introducing inventions and innovator proposals.

Disseminating the initiative of Moscow enterprises -- "Two-shifts for basic equipment," raise the shift coefficient of equipment in the sector by not less than 1.5-fold, increase the number of workers in brigade forms of organization and labor incentive to up to 82 percent of their total number.

Implement measures to improve labor and living conditions, reduce further the number of sections and shops with harmful and difficult labor conditions. Expand the area of sanitary-personal service rooms by 32,000 square meters. Introduce efficiently 6000 square meters of housing above the plan. Insure the utilization of capital investments and fixed capital for manufacturing and nonmanufacturing facilities. Accelerate the further development of works famrs, increasing their number to 150.

We assure the CPSU Central Committee that machine tool and tool building industry workers, rallying closely around Lenin's party, will achieve new successes in fulfilling the tasks of the state plan, the counter plans and the socialist obligations for 1984, and will make a worthy contribution to the further strengthening of the economic and defense weight of the Soviet State.

The socialist obligations adopted by enterprises and organizations were approved at the joint meeting of the Board of the Ministry of Machine Tool and Tool Building Industry and the Presidium of the Central Committee of the Machine Building and Instrument Building Trade Union.

2291
CSO: 1823/129

FLEXIBLE AUTOMATED PRODUCTION UNITS DISCUSSED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Jan 84 p 2

[Interview with Professor P. N. Belyanin, doctor of technical sciences and director of the Scientific-Research Institute of Technology and the Organization of Production, by D. Pipko, SOTSIALISTICHESKAYA INDUSTRIYA editor in the department of science and technical progress, date and place not given: "Flexible Production Units"]

[Text] FAP. This combination of letters is heard more and more at meetings and scientific conferences, and in the conversations of scientists, technologists, designers, party and economic officials. It is linked to hopes for significant growth in labor productivity, and for increases in the effectiveness with which many enterprises operate. In order to accelerate the establishment and introduction of FAP's--flexible production units--the decree of the CPSU Central Committee and the USSR Council of Ministers "Concerning Measures to Accelerate Scientific-Technical Progress in the National Economy" recognizes that it is essential to combine all projects within the framework of all-Union programs.

This means that for many enterprises and even sectors the transition to flexible technology will become the main direction of technical progress in the coming years and will require the efforts of thousands of specialists. In order to avoid mistakes and failures it is necessary to have a clear idea of the potential advantages which are built into the concept of flexible production units, and by what means they can be utilized to obtain the maximum yield. And these were precisely the questions that started off the conversation which D. Pipko, editor in SOTSIALISTICHESKAYA INDUSTRIYA's science and technical progress department, had with Professor P. Belyanin, doctor of technical sciences and director of the Scientific-

Research Institute of Technology and the Organization of Production.

[Answer] I want to emphasize at the very start, the scientist said, that nowhere in the world has anyone managed to set up an FAP in the fullest sense of this concept. Even the automated plant with robots operated by the Japanese Fujitsu Fanuk Company, which has caused such a sensation, is nothing more than a trial effort on the way to a flexible production unit. I mention this because it is by no means everyone who presents the true complexity of the assigned task and of the need to reject a narrowly departmental approach in favor of common interests. And there are symptoms which indicate that in some places the resolution of this task is being approached from opportunistic positions: some enterprises are undertaking to set up flexible production units without having either the scientific reserve, the personnel or the technical base.

However, we do have at our disposal real opportunities to establish highly-effective flexible production units on a consistent, step-by-step basis. The conditions for this have been prepared by party and government decisions, in accordance with these decisions there has been a sharp increase in recent years in the output of machine tools and machines with numerical program control (NPC), industrial robots, manipulators and microprocessor equipment. Experience has also been accumulated in the industrial operation of something close to the components of future FAP's--flexible complexes of machine tools and machines which operate according to a single program. Their main advantage is usually said to be their ability to be rapidly readjusted to manufacture new items. However, the concept of an FAP is to organically combine the advantages of flexible technology and comprehensive automation, which are to be the basis not only for preparing a production unit to resolve new tasks but also for preventing bottlenecks which influence its effectiveness.

The main one of these tasks is well known: in order to make the national economy develop in a dynamic manner industry must provide it with the most modern machinery, equipment, instruments and materials. And for this purpose the utilization of the latest achievements of science and technology is much more effective than it is today. From these positions flexibility in technology is one of the decisive ways to ensure a high level of output by updating it in a timely manner.

[Question] Petr Nikolayevich, does it not seem to you that by pinning our hopes on the flexibility of future production units we are somehow relieving ourselves of responsibility for conservatism and today's delays with the introduction of new equipment? After all, the need to update output does not arise every day...

[Answer] If the difficulties of introducing new equipment derived only from conservatism or the sluggishness of the people responsible for it, we would have obtained satisfaction from them by now. Nor will economic levers solve the problem if opportunities for manuevering are not built into the technology or the equipment of a production unit. And especially because a certain degree of flexibility is necessary for enterprises literally every day. Having caught the spirit of the times, consumers are refusing with increasing frequency to settle for large batches of identical commodities appearing on the market.. And customers placing orders for machinery and equipment, who are concerned about the effectiveness of their production units, are forcing the manufacturer to give mass-produced items particular qualities which they specify.

Under the pressure of these requirements Western firms, for example, have been forced to re-organize production in such a way as to enable them to assemble on one line passenger cars with different finishes, instruments and comfort systems. In this attempt to "entice" the consumer there is also a rational core. Take trucks. The opportunity to make adjustments right on the production line in order to make the vehicle suitable for the conditions under which it will be used--in the countryside, city, desert or tundra--may be of significant benefit to consumers. Consequently, the flexibility of technology is essential to bring the parameters of output as close as possible to the needs and requirements of consumers.

If we look from this viewpoint at present-day machine building from this viewpoint, we must recognize that its technology and the equipment of its plants are poorly adapted for a painless transition to the production of new or modified output. We have become used to citing the large expenditures required for this, although it would be more correct to talk about losses.

When it is necessary to begin producing a fundamentally new item, it frequently turns out that a significant portion of an enterprise's fixed capital--machinery, equipment and tools--is not suitable and needs to be replaced. If the equipment is still in working condition and sufficiently productive, giving it up--even if the cost has been fully recovered--is equivalent to losing previously invested labor, energy and materials. And they must be replaced by large expenditures for technical re-equipment, for renovation and sometimes for the construction of new plants. However, flexible technology makes it possible to maintain the maximum amount of fixed capital and to reduce to a minimum the losses and expenditures incurred when the production of new output is started.

Problems and reserves

[Question] The question of the production unit's need for a high level of flexibility was raised on the pages of SOTSIALISTICHESKAYA INDUSTRIYA as long ago as 1972 in an article by Academician B. Petrov and Professor A. Bulgakov entitled "Program Systems." It concerned, in part, the group utilization of machine tools with NPC, joined together under the control of a single computer and a system for transferring parts from one machine tool to another. But the technological flexibility which is achieved with this system was viewed mainly as a means for raising the efficiency of equipment.

[Answer] This problem retains its timeliness today today. In small-scale production, which accounts for 75-80 percent of machine-building output, the load factor for machine tools with NPC is equal, on average, to 0.4-0.6. And the shift factor at a majority of enterprises does not exceed 1.3-1.6 . If one adds to all this the time taken for preventive maintenance, repairs and similar operations, then it turns out that of the 8,750 hours in the annual time budget, the machine tools are producing output for only 600-900 hours. In other words, only 7-10 percent of their potential is being utilized.

Enormous reserves lie behind these statistics. "We need to revive the movement to raise the shift factor of equipment operation...," Comrade Yu.V. Andropov emphasized in his presentation to the December (1983) plenum of the CPSU Central Committee. "Proof is hardly needed to show that in this way we could substantially increase output and reduce production expenditures." If we could put enterprises onto three-shift operating schedules, 1.5-2-fold more output could be obtained with the same equipment and the same fixed capital.

But the number of people who are willing to work at night grows smaller every day. Neither pay supplements nor other benefits help. In order to take advantage of this reserve, we need to provide for around-the-clock operation of equipment in an automatic mode.

When talking about the advantages of machine tools with NPC, we usually emphasize the ease with which they can be adjusted to produce new items--this requires only the change of a perforated tape with a program recorded on it. But NPC systems have another important advantage: they make it possible to specify programs of great complexity, which include auxiliary as well as basic operations.

Machine tools of the "machining center" type have been designed on this basis: their main feature is a magazine with an extensive collection of various tools.. Any of them is extracted

automatically from the magazine on the basis of a program and put to work. In this way o: "machining center" can fulfill the "duties" of several machine tools: once the part has been put on the work bench, it can be subjected to the most varied types of machining.

In this case the worker's actions amount mainly to putting the blank on the machine and removing it after it has been machined. Industrial robots are quite capable of coping with similar operations for a majority of parts. But the largest stationary base members can be put onto "sputniks," special platforms which are fed automatically by means of a conveyer onto the work table of the machine tool and take up the necessary position on it. If several "sputniks" with parts are loaded onto the conveyer, the machine tool will be able to operate for days without human intervention.

[Question] But what is the connection between this technical design and the ideas of flexible production units?

[Answer] A very direct one. Having loaded the magazine of this machine tool with the necessary tool, "sputniks" with the blanks of various parts can be put on the conveyer. And in this way high technological flexibility is achieved. It is true, that this requires NPC systems which are capable of keeping whole "libraries" of control programs in memory and putting them to work. But this task is completely resolvable given today's microprocessor equipment.

Machine tools and machines with NPC, which are equipped with the means for automatically changing a tool and for feeding parts, as well as with other systems which provide for the "people-free" manufacture of various parts and for operations over an extended period of time, have been called flexible technological modules (FTM). These modules can be created not only for metal-working, but also for foundry, forge-and-pressing, electroplating and other shops. They can be viewed as the components out of which the flexible technological complexes are built.

[Question] Judging by Minister B. Bal'mont's comments in the press, specialists in the Minstankoprom (Ministry of the Machine Tool and Tool Building Industry) intend to proceed with the widespread production of these various modules. And they do not exclude the possibility that the modules may be used as independent units. And will we not encounter here the same problems that we encounter when introducing machine tools with NPC and industrial robots? The appearance of one module in a shop will hardly increase the flexibility of technology in a noticeable way. And you would not leave it operating over night without monitoring it. At the very least you would need an electrician, an adjuster and possibly other specialists.

[Answer] In any new project you cannot avoid intermediate stages. Using the example of machine tools with NPC, and then robots, we rapidly became convinced that they provide the maximum effect if they are used in large groups. This conclusion also applies to the flexible modules. For this reason the basic strategy for their application will be linked to the process of combining them into flexible complexes. And especially because by themselves--if they are not in complexes--the modules do not solve problems related to the maximum utilization of equipment potential.

The path leading to complexes

[Question] One of the characteristic features of present-day equipment is the steadily increasing complexity of items, parts and units. For example, some parts, in order to acquire final form, must undergo machining at 50-70 universal machine tools. Or at several "machining centers." In these situations the question inevitably arises as to the best way to distribute operations among machine tools.

[Answer] When we are talking about one part, this task can be solved by even a beginnning technologist. But when we talk about the flexibility of a production unit, we imply that the most diverse parts will be machined in one production line. Moreover, this kind of production unit must be prepared at any moment to shift to the production of new items. In other words, with the appearance of every new part, the question of the equipment load must be resolved again and in the minimum time period. And in the process one strives for the most advantageous, optimal solutions. From this there arises the idea of subordinating a group of flexible modules or machine tools to one computer. This kind of unified computer control provides the first level of equipment integration which makes it possible to make the maximum use of the potential of a group of machine tools through the optimal distribution of operations and the synchronization of work.

True, another problem arises here immediately: how can we provide for parts to be passed on from one machine tool to another? At first glance one is tempted by the idea of arranging them along the conveyer and obtain a kind of traditional transfer line, but this idea does not stand up to criticism. The time for processing at each machine tool is different. For this reason the speed of the conveyer will hold up the "slowest" of them. But the main complexity lies in the fact that each new part may have to be transferred from machine tool to machine tool in a different sequence.

[Question] As far as I know the designers of a number of flexible complexes both at home and abroad have limited themselves to leaving transport operations to workers who have been provided

with the necessary equipment such as battery-operated carts, for example....

[Answer] At the first stage even this way out of the situation should not be dismissed. Especially if the complex consists of two or three machine tools and the machining of every part takes a relatively long time. But a flexible automated transport system (FATS) provides a radical solution to the problem. The principle of "return to one place" can be made its foundation. The essence of it is that the transportation lines from all the machine tools come together at the warehouse for blanks and parts, which plays a role as a kind of "junction station." From its cubicles the blanks are sent to the machine tools by automatic carts called "robocars," for example. And they are returned here after machining. In summary, through this warehouse the part may be sent--with or without pauses--from every machine tool to any other in the complex.

For comparison one can recall here the usual transfer lines, where parts are passed from unit to unit strictly in one direction. Here the part cannot be sent "against the current," in order for any of the units to be used over again. For this reason if three drilling operations, for example, must be performed on a part, and they cannot be combined, then three drilling units must be built into the line. However, a flexible transport system provides a second level of equipment integration which makes it possible--through the repeated utilization of each of the machine tools--to increase their load factor and reduce their number.

There is one other problem related to tools. Under the conditions at which the machine tools with NPC operate, they break down rapidly. This has been taken into consideration, and the magazines of the "machining centers" usually have in reserve several sets of the same tool, enough to last for a 24-hour cycle. But if we wish to increase this period to one of weeks, months, or even years, then we must be concerned with the automatic renewal of the tools within the magazines themselves. This requires a flexible automated tool system (FATS), which provides a third level of integration; this makes it possible to increase the length of "people-free" operation of the machine tools to periods which are limited only by their reliability.

This kind of equipment integration opens up broad opportunities for production. If, for example, it is necessary to manufacture several different parts, the controlling computer may initiate the work on them one after another, synchronically passing the appropriate machining program to each of the machine tools. However, simpler parts will be machined in a parallel manner, and for this the computer will separate "its" machine tools into temporarily independent groups, as it were. Finally, when one of

the machine tools gives out, the computer will immediately distribute its duties among the remaining ones.

In short, several flexible technological modules, brought together under the control of a single computer by an atuomated transport and tool system represent a single flexible technological complex (FTC). In order to adjust it for the manufacture of new parts, it is sufficient to introduce the appropriate program into the central computer.

While providing for three-shift operations in an automated mode, these complexes make it possible to increase labor productivity 3-4-fold, to bring the load factor for equipment up to 0.85-0.9, to reduce the cycle for machining parts 2-3-fold and to reduce production costs 3-5-fold. At the same time the need for machine tools with NPC is reduced 2-2.5-fold and there is a corresponding saving of production space.

The end goal

[Question] The degree of technological flexibility which is essential to an enterprise depends on the nature of its output. Clearly the preparaticn necessary to bring many innovations to the stage of commercial production can be done in advance.

[Answer] In a number of cases the question is posed in an extreme form: the production unit must be potentially ready and able to shift at any moment and within a short period of time to the production of new or modified output. For this all the operations which are part of the engineering and technological preparation of the production unit must be automated on the principles of flexible technology. In other words, this requires the establishment of auxiliary flexible complexes with their own systems of automated planning (SAP). These complexes may be brought together in an automated system of production preparation (SPP), which is capable of serving several technological complexes.

Hence it can be said that flexible automated production unit is a structure comprised of several flexible technological complexes, which are served by a flexible system for the preparation of production. A central computer for the entire FAP may be directly linked to an enterprise's automated control system, providing a direct link between the planning-dispatch calculations and the control of the production unit.

As an example of an FAP, one can take a unit for the production of gear boxes. Having received an order for the output of a new model, its central computer will switch on the automated planning system to design parts. The results of these calculations will be utilized to resolve the tasks of how to "insert" the manufacture

of a new model into the same assembly line with those already being produced. Finally, the central computer will distribute the manufacturing of the pinions, shafts, casings and other parts among individual flexible technological complexes. And the latter, in turn, will switch onto this task the auxiliary complexes of the production preparation system. The central computer will provide information to the enterprises's automated control system (ACS) about the state of readiness for production of a new gear box, and the ACS must ensure the shop's supply of blanks and other necessary items.....

[Question] What are the major difficulties holding back the emergence of flexible automated production units?

[Answer] As of today one can say that the principles for setting up an FAP are already well known. The route to their realization includes the further improvement of flexible complexes, which requires the solution of many difficult technical problems. I would include among the most important the problem of software--how to provide those algorithms and programs which make it possible to utilize the computer's advantages. In the flexible complexes and the FAP's, difficult management, organizational and planning tasks must be resolved on the spot, so to speak, during the actual production process.

Questions of reliability require particular attention. With regard to equipment, the so-called mean-time-between-failures, especially the time before the first failure occurs, serves as one of the indicators of reliability. If in relative terms this indicator is given a value of one for the usual universal machine tools, then machine tools with NPC have a value of 0.4-0.6, while robotized modules have a value of 0.3-0.4. And with transfer lines this value may fall to 0.25-0.3. This reduction in reliability results from comlpexity and the fact that the structures have many elements, which are an order of magnitude higher with an FAP. Nonetheless, in order for an FAP to operate with maximum yield the time-between-failures must be 8-10-fold greater than with universal machine tools.

Moreover, when FAP failures do occur, operationality must be restored on the spot, as they say. Or, at the very least, it must restored with a speed which is no worse than it is for universal machine tools. Otherwise, idle time "eats up" their advantages.

It goes without saying that the reliability of flexible complexes and FAP's largely depends on the reliability of the equipment and facilities which go into them. In particular, the continuous operation time of NPC systems must be raised to 2,000-5,000 hours. The reliability and service life of computers must be

brought to between 10,000 and 20,000 hours. And the reliability of tools must increased 3-4-fold.

The focus of programs

[Question] In essence the discussion concerns the fundamental technical re-requipment of all machine building with its many branches; this requires enormous expenditures. They can be reduced only through the efficient organization of all operations, the coordination of research and design, the specialization and cooperation of production and the step-by-step transition to increasingly flexible complexes and production units. Toward this end, in fact, a decision has been taken regarding Union-wide programs on flexible automated production units and systems of automated planning. But what kind should they be?

[Answer] In my view these programs must organically link two basic directions in the work--the design of flexible complexes and FAP's on a fundamentally new technical basis, which is being developed gradually, and the introduction of flexible technological complexes comprised of equipment currently in operation or production. Today the situation is such that attempts to create flexible complexes are undertaken not only by the scientific-research institutes and design bureaus of many sectors, but also by individual enterprises. Their desire to incorporate quickly the advantages of flexible technology can only be welcomed. But at the same time it is necessary to eliminate the danger of primitive, ineffective solutions and the appearance of masses of "home grown" equipment and units, which require exorbitant expenditures to manufacture, service and repair. It is also necessary to be on the alert for the possibility of this "initiative from below" outstripping scientific recommendations and normative prescriptions which could direct it into a single channel.

From this viewpoint, one of the top-priority tasks is to develop within the shortest period of time a unified scientific strategy for the establishment of flexible production units. There must be norms--mandatory for all sectors--which ensure that pieces of equipment are operationally compatible and standardized and that existing units can be replaced with updated models. Moreover, the unit-plant principle of building an FAP based on standard types of plants and their sub-units must be made the basis for the scientific-technical strategy.

We are also talking about the establishment of an "element base" of an FAP and about the development and organization of the production of units and sub-units from which one can put together multi-operation machine tools and other technological equipment and controlling devices for all FAP systems, as well as automated transport and tool systems with their robots, automatic carts and warehouses. Particular attention must be devoted to the

development of systems to monitor tool wear and the accuracy of machining directly "on the spot" and to diagnose the state of equipment and control devices.

The creation of a majority of these FAP components essentially represents an independent scientific-technical direction. Accordingly, for each of them it is necessary to have scientific-tehnical programs, many of which will be inter-sectorial in nature. Moreover, unless the enterprises of many sectors are brought into this work, it will hardly be possible to carry out the widespread production of the necessary equipment. For this reason it is advisable to have--for the basic directions related to the development of the equipment for an FAP--head design organizations led by general designers. They should be granted sufficiently broad powers, especially on questions related to the realization of the unit principle...

[Question] Unfortunately, using the example of the robot equipment one can conclude that the unit principle will make its way into life only with difficulty. Purely prestige considerations frequently result in the sectors creating "their own" robots, "their own" control and other devices. And there are few who agree to produce "faceless" units for many consumers. Where is the guarantee that this will approach will be successfully implemented in the development of flexible complexes and FAP's.

[Answer] The guarantee must be the understanding that only the unit principle will make it possible to resolve the set task with the minimal expenditures of forces and resources. The same machine tools, robots and even automatic production lines may be utilized with equal success at an automobile or at a combine plant, for example. But the flexible complexes and the FAP embody a whole technological chain, the features of which are frequently determined by the nature of the sector and even by the specific features of the production unit at a given enterprise. In other words, in every specific case their own plans and designs are required. It is clear that a reduction in the volume of design work here can be achieved only through the broad utilization of standard units. At the same time, it is wise to carry out the design of specific flexible complexes and FAP's within the framework of sectors, having assigned the design work to the head technological organizations led by general technologists.

[Question] But with such a plan there must be someone to conduct a unified scientific-technical strategy removed from narrow departmental influences. Maybe it would be advisable to establish for the scientific-methodological leadership of all these operations a State Scientific-Research Institute on Flexible Automated Production Units, which would come under the USSR State Committee on Science and Technology or the USSR Academy of Sciences? One

of the basic tasks of such an institute could be to prepare scientifically-grounded proposals on prospective and controversial questions related to the establishment of flexible production units. And subsequently it could also monitor the fulfillment of decisions taken on the basis of these proposals.

[Answer] I do not think that any institute will be able to cope with these tasks. The largest of the questions which arise can be resolved only at the government level, and the current questions can be solved only at the level of the councils of general designers and general technologists. And the preparation of the proposals can be entrusted to temporary commissions which are being set up with representatives from various agencies. And a flexible management system should help to establish the flexible production units...

[Question] Petr Nikolayevich, could you set out a general line in the strategy for introducing flexible complexes and FAP's?

[Answer] Perhaps it should consist of first trying to shift inter-related production units to flexible technology. Let us say that today an enterprise can be prepared to produce new output. But it will not be able to make the shift if related enterprises have not mastered the new related parts. In order to prevent this kind of dependence, many enterprises return to a "natural economy": they themselves begin to manufacture items which are not within their area of expertise, and this is reflected in the profitability of production. It is clear that the picture changes radically if all the partners are given the opportunity to effectively assimilate innovations. With this kind of approach, flexible technology opens up ways to intensify specialization of production its intensification on the scale of the entire country.

Nonetheless, the main significance of flexible automated production units consists of the fact that by increasing labor productivity 8-10-fold, they change our ideas on the nature of work in fundamental ways. The main figures at the enterprises become the complex operators, specialists in electronics, precison mechanics and precision drive and highly-skilled trouble-shooters. Many of these occupations require not only secondary but also higher specialized education.

Comrade Yu.V. Andropov emphasized that "we must work persistently to resolve the tasks of mechanizing and automating production because of the socio-political significance of these tasks. When man is freed fom heavy, tiring manual labor, he demonstrates, as a rule, great initiative and responsibility for the assigned work. He receives additional opportunites for study and recreation and for participation in social activities and the management

of production." It is for this reason that the party has set the task of making widespread use of the advantages of FAP's.

PHOTO CAPTION

1. p 2. On the left: The ASV-20 flexible complex, designed by specialists at the Experimental Scientific-Research Institute of Metal Cutting Machine Tools; On the right: The SM-400 model "machining center" of the ALP-3-1 flexible complex, equipped with an automated tool system.

8543
CSO: 1814/89

AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

FLEXIBLE MACHINING CELLS, ROBOTS IN WATCH MANUFACTURING PLANT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 17 Feb 84 p 4

[Article by A. Kurbatov, general director, Zavod imeni Maslennikov Production Association: "Robots Speed Their Way to the Shops"]

[Text] As recently as three years ago the picture you would have seen in the watch factory's assembly shop would have had dozens of women using miniature tweezers and the simplest of instruments to straighten wheels for watch works which had been bent during the stamping process.

These operations are now performed by a dozen robots attended by a single human. Labor productivity here has risen 4-fold. Product quality is better as well: functional failures in these watch mechanisms due to plane or radial irregularities have been elminated entirely.

This only one example of implementation of the integrated plan to mechanize, automate and robotize production between 1981-1990 developed by association specialists. Two hundred ninety industrial robots, automatic operators and mechanical arms are now in service.

Association socialist obligations for 1984 include the following: "Bring four new robotized production systems on line." What will implementation of this item in our obligations do for us? It means automating the hot die forging of watch casing billets, the cold stamping of mounting plates for the works and calibrating components fabricated by powder metallurgical processes. All these operations are in the category of what you would call heavy and monotonous labor.

Now the specialists might think: "Just four robotized systems?! This is way too few for for such a solid production association." And they're right: we should have more than 100 systems like this. These four, though, are the most critical. They represent the first advance in our assault upon manual labor at the heart of the production process—at the production fabrication stage.

This year, for example, we're going to be working on a robotized automatic lathe. It in turn will form the basic component for the enterprise's first robotized system for machining watch components.

We're a month and a half into the new year now. What have we been able to accomplish during this time? The enterprise has been provided with all the necessary

technical documentation. The shops have studied it, and production of the equipment involved has begun. And we have purchased the industrial robots required to equip these systems.

We have weekly "automation days." On these days we take a close look at how we're doing in terms of our operational schedule. So far, we haven't fallen off the schedule we're trying to follow in introducing these systems.

Our obligations, which in fact were published in SOTSIALISTICHESKAYA INDUSTRIYA, reflect only part of the tasks involved in our effort to automate production operations, tasks which we are working on during the current year. We have begun work on the development, for example, of automated multiprocess facilities. Work is now being completed on the automatic robots for two of these facilities.

An automated multiprocess facility for shaping, inspecting and sorting spring components will make it possible to assemble all types of them. We will be able to cut the number of people performing these operations by almost one-third. With the second facility we will be automating the assembly, adjustment and inspection of watch wheels. It, too, can be quickly adjusted to assemble "wheel-pinion" assemblies of any type size. These devices will free up 18 assemblers and inspectors. I think both facilities will be fully operational by the end of 1985.

It could be said that the automated multiprocess facility is being developed on the basis of technical solutions and devices the association developed earlier in the process of introducing its automated production-process control systems. The automated system for controlling machining operations includes a system for controlling NC machine tools as well as one for controlling and monitoring the operation of automatic equipment. Another automated control system incorporates the first automatic television computerized control robots for checking component quality. Automatic laser devices the association has developed have been installed in a facility which checks and adjusts balances for our watch works. These devices have freed up some 100 workers.

It would not be advantageous to try to design each one of these automated multiprocess facilities individually. We therefore set about the task of developing modules for use with these systems—adaptive assembly robots and operational function modules. Collaboration with scientists at the polytechnical institute in Kuybyshev has been a big help here. Together with a group in the Integrated Robots Department, for example, we are developing a general-purpose orienting device referred to as an "eye-hand module." It will be able to select individual pieces from out of a group of pieces, orient them and move them to an assembly or processing area in the proper position.

It has also been seen to have been a good idea to form a separate group of designers to develop automated systems and specialists for fabricating, introducing and then providing qualified operators for this equipment.

I would like to say something at this point about some of the problems that still remain unsolved. We could have been making our own high-precision kinematic pairs and wave reducers, which you can't build a robot without. We don't have enough machine-tool building capacity, though, and the Ministry of the Machine Tool and

Tool Building Industry cannot supply the high-precision grinding, coordinate boring and gear hobbing machines. We're also suffering from critical shortage of small sensors and drive mechanisms, what with the fact that the Ministry of the Electrical Equipment Industry is not setting up to make them on any large-scale basis.

It really isn't necessary to demonstrate how important it is at this stage in the development of robotics to coordinate the efforts of specialists and the various groups working in this field. Unfortunately, however, neither the information services of the USSR State Committee on Science and Technology nor the oblast scientific and technical information centers are providing us with information on work under way or planned in the field of robotics.

8963
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AUTOMATED LINES AND AGGREGATED MACHINING SYSTEMS

UDC 621.9.06-529.003.13

EFFICIENCY OF AUTOMATED PRODUCTION OF MACHINE TOOLS FOR TRACTOR PLANTS

Moscow MASHINOSTROITEL' in Russian No 11, Nov 83 pp 5-7

[Article by G. Z. Al'tmark: "Utilize Efficiently Machine Tools with ChPU"]

[Text] In 1982, the Moscow "Stankostroitel'nyy zavod" imeni S. Ordzhonikidze Production Association, one of the first in Soviet machinebuilding, became 50 years old. For its great contribution to the development of domestic machine tool building and for providing the economy with highly automated metal-cutting equipment, the association was awarded the Order of the October Revolution and the rotation Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the VTsSPS and the VLKSM Central Committee, as well as being recorded on the All Union Honor Board of the USSR VDNKh.

Many glorious labor initiatives were born or supported in the association. The machine tool building collective became one of the initiators of socialist competition for the wide introduction, in production, of the achievements of science and technology. The Ordzhonikidze workers obligated themselves to do the following by the end of the current five-year plan period as compared to the plan: reduce labor-intensiveness by 12 percent, metal consumption by 11 percent and power consumption by 7 percent. The replacement and modernization of outdated equipment and further improvement in production will make it possible to free about 1000 manual laborers conditionally and save 3 million rubles.

Products of the enterprise are high productivity automatic lines, special and aggregated metalworking machine tools for the tractor and other sectors of industry. These products are made in small series. A large volume consists of single parts of aggregated machine tools and automatic lines with some of the parts being very large. All this complicates production and does not always permit the introduction of mechanization on the scale possible in large series production. Nevertheless, ways are being found at the enterprise for solving this problem.

Valuable experience was accumulated in the association of efficient introduction of scientific developments and reequipment of production. The collective established close ties with 15 scientific research institutes and vuz in the country which help solve urgent production problems. The course taken by the

enterprise is on reequipment and supplementing technological equipment with new progressive types of machines, primarily metal-cutting machines with ChPU [Numerical control].

Fig. 1. Section for turning spindles and large shafts consisting of models 1B732F3 and 1740RF3 machine tools of their own production. Model 1740RF3 machine tool can machine parts on centers and in chucks; it has an automatic backrest and a 12-position rotary head.

Certain successes have already been achieved in this direction. The most varied parts -- pinions, disks, flanges, shafts, plates and large housing parts are machined on over 50 machine tools with ChPU. A method for automatic preparation of control programs is used and a great deal of attention is given to raising economic efficiency in using machine tools with ChPU when machining especially complicated parts; work is being done on combining such machine tools and industrial robots into automated sections with computer control.

The efficiency of using machine tools with ChPU depends, to a considerable extent, on the proper choice of the kind of machined parts taking into account the following: determination of the size of the lots of parts (based on annual production program) and the assumed labor-intensiveness of their machining; investigation of possibilities of complete machining of parts on one or two machine tools and group machining of parts with simultaneous servicing of several machine tools; identification of special technological features of machining parts; determination of requirements of universal and

special technological features of machining parts; determination of requirements of universal and special cutting and auxiliary tools. This work helped in correctly selecting the type and amount of equipment and in determining its efficient loading.

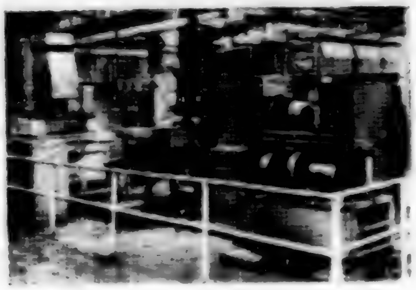

Fig. 2. Section of machine tools with ChPU models 2R135F2, 6R13F3-01 and MA396F3 for machining parts that have curved surfaces.

When universal equipment was replaced by machine tools with ChPU, the advantages of numerical control became obvious. Thus, parts machined on machine tools with ChPU are always of high quality when sent to the Quality Control Department. Labor-intensiveness of their manufacture was reduced considerably.

Obtaining stable dimensions of the turning lathes made it possible to reduce allowances for grinding, and the consumption of abrasive material, and achieve high productivity of labor.

Improvement of machining technology on machine tools with numerical control dictated the creation of sections consisting of several types of machine tools for comprehensive machining of a group of selected parts. The plant has four such sections. An analysis of their work made it possible to determine the technical requirements of modern machine tools with ChPU. Such a machine tool should machine a maximum number of parts in the automatic cycle which is achieved by equipping the machine tools with turrets and tool magazines, using contour ChPU arrangements, and improving the fixtures and the cutting tools.

Models 6R13F3 and 6R13RF3 machine tools with ChPU are used at the enterprise for milling plates, guides, housings and flat parts that come in lots (15 to 40 pieces), as well as parts with curved shapes. The same machine tool machines single parts with curved shapes for aggregate machine tools and automatic lines.

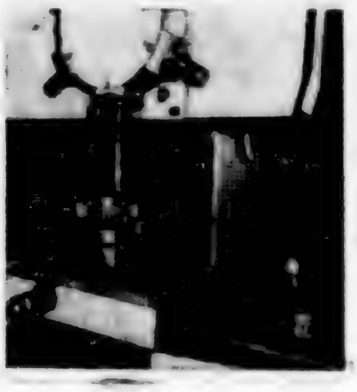

Fig. 3. Three-cam self-centering type 67206-4079 type hydraulic chuck installed on the model 2R135F2 machine tool.

An analysis of parts machined at the enterprise indicated that the ratio of milling and drilling operations is 3:7. In the comprehensive machining of parts on the machine tools of the milling-drilling group (milling slots, steps, lubricating channels, drilling, reaming), productivity decreases due to the low speed of the idle strokes and frequent repositioning in drilling operations. The productivity of machine tools in the milling-drilling group for comprehensive machining increases and in that case makes up 70 to 80 percent of the operation time. This is achieved by increasing the idling stroke speeds to 8-12 meters/minute; reducing acceleration and braking times, as well as the time for replacing the tools and the implementation of other technological and auxiliary instructions (4 to 6 seconds).

Innovators and specialists of the association help greatly in expanding the possibilities of machine tools with ChPU. Thus, to machine parts of the flange type on the model 2R135F2 drilling machine tool they, together with the Orgstankiprom specialists, have developed special hydraulic chucks which make it possible to reduce the time for positioning and removing parts, raise the basing accuracy and reliability of clamping and ease the manual labor of the machine tool operator. Universal-assembly readjustable accessories designed and

manufactured at the enterprise are used widely on this machine tool as is a plate with a coordinate grid of holes that make it possible to change over rapidly to drilling practically all types of flat parts of any configuration.

In creative cooperation with scientists of the MVTU [Moscow Higher Technical School] imeni N. E. Bauman thread cutting was mastered on the model 16K20F3 machine tool which could not be done for a long time before. Optimal modes were identified for obtaining high quality threads with little time taken for adjusting and readjusting the machine tool in the process of thread cutting.

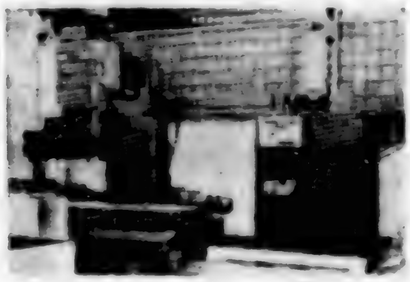

Fig. 4. Machining of medium size housing parts on a machining center with a magazine for 48 tools. The machine tool is installed in a jig boring section and does boring, drilling and milling operations with an accuracy of mutual location of holes within $\pm$ 0.03mm.

To drill high-grade holes in pinions, worm gears, bushings, disks and other parts using models KT141 and 16K20RF3 lathes, innovators proposed a floating chuck for reamers of up to 25mm in diameter. Its introduction will make it possible to obtain accurate machine tool positioning within 0.025 to 0.03mm and increase the precision class of machining.

High efficiency with labor-intensiveness which is reduced to a third is obtained in machining housing parts for automatic lines and for certain parts of series manufactured machine tools in a machining center, which provides a stable accuracy within $\pm$ 0.03mm. A special device, mounted on the spindle, compensates automatically for linear vibrations of the tool which eliminates its adjustment along the length outside of the machine tool. The spindle moves at a high speed but as soon as the part is touched, the working feed is switched in.

Operating experience of the model 24622F2 boring machine tool indicated that machining single parts and nonrepeating small lots (up to 10-20 pieces) is most advisable in the positioning mode. Therefore, in the association, where the nature of production is of single and small series parts, boring machine tools are used with a preliminary setting and digital indication of the model. At present, models 2623PMF4 and IR800MF4 are being installed in the general technological line for machining housing parts. Most labor-intensive repeating parts (in lots of 10 to 15 pieces) will be selected for machining in these centers.

Raising the productivity of labor and insuring high quality of machined parts required the machine tool plant workers to carry out the following organizational-technical measures:

transformation of the technological process to provide stability of the intermediate products with respect to dimensional allowances and physio-mechanical properties, implementation of thermal operations (normalizing, etc.) of forgings, maximum concentration of operations;

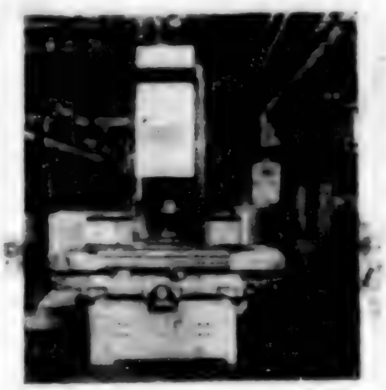

Fig. 5. Model MA396F3 contour grinding semiautomatic machine tool with ChPU.

tool preparation for production that will supply the machine tools with two sets of fixtures, organization of preliminary alignment and procurement of the tools;

provision of production with good quality documentation of operation-by-operation technology, adjustment charts and control programs.

Fig. 6. Dispatcher control panel of a type OR3-3 comprehensively mechanized section with a transportation housing system for servicing eight machine tools for machining small flat parts (including six machine tools with ChPU).

An operation service was organized to accelerate the introduction of machine tools with ChPU in shops of the association. A bureau for introducing programed control (BVPO) for sections of machine tools with ChPU has the following duties: prepare control programs and debug them, provide tools and carry out experimental work. A special bureau was organized to service systems with ChPU. Shop mechanics repaired the mechanical and hydraulic parts of the machine tools.

The following order was established for machining parts on machine tools with ChPU: the technological bureau and groups of the chief technologist's department together with the BVPO select the list of parts; the BVPO issues the specifications for the development of the operational technology, adjustment charts and the control program. Adjustment and correction of the control program are made directly during the machining period of a lot of parts. A statement on the suitability of the part, on the identified faults and the actual machining time of the part is formulated according to the machining results. The statement is signed by the BVPO chief, the technologist, the section foreman and the Quality Control department and is approved by the chief technologist. After that, all technological documentation is finally corrected.

Blanks are ordered (up to five blanks depending on their complexity and cost) for debugging programs for machining new complicated parts or parts that require special fixtures or tools. These are used by the adjuster, technologist and programer to debug the machining program.

The technological laboratory of the plant participates in selecting cutting modes and tool geometry to obtain the required fineness, and geometrical and dimensional accuracy. The debugging stage is completed by formulating a

statement on the introduction of machining the part on a machine tool with ChPU which serves as a basis for correcting the route technology of machining the part.

An important role in raising the efficiency of equipment with ChPU is played by the proper selection of the tools and auxiliary accessories. Catalogues were developed to limit the number of tools and accessories. In turning and turret machine tools, as a rule, cutters are used that have hard alloy, nonregrindable quickly replaceable plates, adjusted for size outside of the machine tool in a special device. These cutters are intended for external turning, boring, cutting grooves in external surfaces and in holes. Cutters are used in machine tools for milling outer straight and sloped surfaces and for machining grooves, steps and channels.

Fig. 7. Drilling machine tool with ChPU with a special coordinate plate for drilling. The machine tool permits reducing the number of accessory assemblies for ChPU by 20 to 30 per month. Readjustment is made directly on the machine tool. The introduction of this machine tool saves 1200 rubles.

One of the basic conditions for the most rapid mastering, efficient operation and expansion of the application area of machine tools with ChPU is preparing qualified engineers, technologists and operators. Their preparation is in design and operation specialties.

The experience of utilizing machine tools with ChPU indicated the correctness of the chosen way: the manufacturing cycle of parts, the time and cost of their transportation decreased and the duration of the monitoring operations also decreased. High concentration of operations on one machine tools simplified planning and control. In combination with the constantly developing system of production organization based on the mechanized gathering and recording of data, automated planning with the aid of a computer and the

introduction of machine tools with ChPU became efficient means for raising the productivity of labor in small series production.

An increase in the quantity of equipment in production makes it possible to increase the output of high productivity progressive machines systematically.

Thus, flow-line production of multispindle turning automatic machines is developing in the association, production of single and double-spindle turning semiautomatic machines with ChPU was mastered and a new rapidly-readjustable five-spindle turning horizontal and high productivity automatic machine model MR160PF3 for machining parts with diameters up to 160mm was developed. Also, a series of multispindle horizontal chuck automatic machines with ChPU was developed.

The collective faces great problems in implementing the Provision Program. Some 124 automatic lines and over 700 aggregate and special machine tools will be manufactured for the Minsel'khozmash [Ministry of Tractor and Agricultural Machine Building]. Their introduction in enterprises of the country will save 2.3 million rubles and the labor of 5000 workers. To solve these problems successfully, the plant workers are putting into action all unutilized production reserves and are insuring a regular output. The efficient use of machine tools with ChPU will play the main role in this.

2291
CSO: 1823/127

ERRATIC PROGRESS WITH IMPLEMENTING FMS, COMPUTERS AT ZHDANOV PLANT

Leningrad LENINGRADSKAYA PRAVDA in Russian 3 Jan 84 p 2

[Article by Ya. Strugach: "Birth of a Firstborn"]

[Text] Here in the hull machining shop, much resembling the deck of a ship: metal ladders, railings, deckings over steel sheets, moving down over roller conveyors, and what appeared to be a captain's deck cabin, a separately standing structure, that everybody looked at from time to time, awaiting the command. And it came, sounding entirely against rules, to those in the shop who were usually to be found near the plasma flame zone.

"Everybody -- away from the machine!" -- was finally heard in the section.

When the people fell back, just in case, a bluish blinding plasma flame flared up suddenly: the cutter moved above the sheet of metal and confidently began to draw one rectangle, then another one and then other figures. It was somewhat strange to see no operator.

This is how operating tests of the so-called flexible production model began at one of the shops of the Shipbuilding Plant imeni A. A. Zhdanov. By the way, it still remains to become the production in the full sense of the word. It will be transformed into an automatic section, a shop, but so far the first and most important step has been taken in that direction. Now Leningrad shipbuilders have convincing confirmation that this was the correct step in all respects.

So far, existing flexible production facilities can be counted on the fingers of one hand. They are met more frequently in discussions by scientists, rather than in plant shops. Their very name evokes a more or less clear-cut image in only a few specialists.

People refrain from speaking about a flexible automated production facility. They speak of a production module, the first cell of a future complex. Here is a computer, there is another smaller one; here is a numerical control device and beside it -- peripheral devices: displays, graph plotters. From here instructions are issued to the plasma metal-cutting machine of the "Kristall" type. All the equipment is ours, domestically made.

Thus, the device of this complex is described briefly to the uninitiated but, in a particular technical document, various special words are used about it: radial interface, dialogue languages, and functional software. Well, all this must be known now and it is necessary to relearn it gradually, erasing from memory such concepts as manual cutting, templates, contour followers...

Vladimir Romanovich Rukhlinskiy, chief of the hull machining shop looks at what is occurring in his shop with that practicality of a production man in which optimism with respect to new equipment does not go beyond the control of today's concerns. Yes, the first flexible module proved its efficiency, but did not eliminate the operator fully. So far, it has brought nothing to the shop yet besides additional concerns and expenses, but the future belongs to such equipment. Thus, reasons Rukhlinskiy.

These reasons are given from experience. Vadim Aleksandrovich Simakov, deputy shop chief, began here by learning to hold a gas jet in his hand. He operated it for several decades, crawling on his knees over sheets of metal.

Felix Vital'yevich Vas'ko, chief of the hull design technological department, came to the plant when manual cutting was replaced by semiautomatic machines. They cut the metal using life-size templates of future semifinished products. Then, semiautomatic photocopying machines appeared and the tedious work involved in the manufacture of huge numbers of templates was forgotten, although the templates now had to be drawn on Whatman's drawing paper in a reduced size.

The present workers sitting at the "Kristall" machines did not see any of this. Many of them, PTU [Trade technical school] graduates, are even younger than the machines. They very seldom use the gas yet but are thoroughly informed about the gas plasma originating in the high voltage field, the interpolator, a paper tape reader that makes the machine cut out parts from sheets according to a program rapidly and efficiently. They also know that the tape is punched out as a result of calculations and coding parts and layout charts which is done by special workers.

Labor content, not to speak of working conditions, productivity, etc., depends on equipment standards. In the hull machining shop of the plant, you can see traces of several stages of the scientific technological revolution. In the last three decades, the labor of workers in manufacturing parts of future ships was reduced in volume and went through qualitative changes. And, the time has come for the following stage.

Less than two years ago, Stanislav Nikolayevich Kaverin and Sergey Plavlovich Yurkin, two recent graduates of the Moscow School imeni Bauman, were invited to work at the plant. They, who were never in Shipbuilding shops before, had to make sense of the entire work of people -- from drawing ship parts, developing the technology of their production to the movements of the plasma cutter along the sheet of metal. All this had to be "described" by mathematical means. At that moment of a flexible production module, development began at the Plant imeni Zhdanov.

Kaverin headed the group for writing the GAP [expansion unknown] software. Vas'ko described him as follows: "He has a unique specialized skill. Imagine an engineer with the knowledge of electronics and mathematics!"

The computer had to be "taught" to operate with a specific mass of numbers and symbols that reflected all the activity of the people in the hull machining shop. Vladimir Nikitin, deputy chief of the department, and Aleksandr Nikolayevich Popov, deputy chief technologist, headed the development of software and modernizing of electronics. One institute undertook to develop and manufacture an important device, promising to make it in a few years. The plant specialists solved the problem in a few months.

Workers of the "Ritm" Association joined in the work, helped with the software and designed the device which automatically regulates the height of the cutter above the sheet of metal.

There were doubts as to whether it would be possible to "tie-in" all the electronics to the "Kristall" machine that was not calculated for such a level of automation. It is an extremely complicated thing and it was explained to me using the most unexpected images: "You understand that a man and a dog cannot speak to each other, since they have different languages. If a device were made which would translate their language into some third one, then they could express themselves to each other. We made something like that for our machines."

In April of last year, the basic participants in developing the flexible module met in the office of Genadiy Vladimirovich Filatov, chief engineer, and a work schedule was signed. Everybody agreed to the approved completion schedule of September 1984 although development had just begun and nobody could foresee the surprises, difficulties and problems that might arise on this path.

By the way, one problem out of many that came up at the very start and while everybody understood that it appeared to be secondary and even very prosaic in the background of other mathematical and electronic problems, it could later on ruin the entire work. Outside specialists were very pessimistic about the solution to this problem and gave gloomy, indefinite predictions, stating that there was not yet enough experience.

The problem was that all computer equipment was to be placed within the hull machining shop where the metal was prepared, where the impacts of heavy presses could be felt and where there were also electrical noises unseen by the eye but most disastrous to electronics. Thus, it was necessary to devise all kinds of measures to protect the computer and take risks.

The chief engineer followed everything himself. "You know," I was told, "Filatov is the soul of the entire work." This was more than just management. Every three days he met with participants in the development of the module. Everything was then clarified: what was already done, what should be done on a priority basis, who should be helped and who should be punished.

At one of the meetings, the completion date of the work was discussed: "Why September 1984? January would be much better." The date was changed to January. After some time, it was changed again to December 1983. It was decided that the sooner the first result was obtained, the more time would remain for its development and debugging, if errors did occur.

The work mode of all participants in the module development became extremely rigid. At the chief engineer's meetings, it was not permitted to say "did not turn out... I can't ... cannot be done..." Saturday, Sunday, and the night shift were considered the best times. Once the chief engineer saw that Kaverin and Yurkin were as tired as could be and decided to send both to the plant's dispensary. They could rest and eat there and it was close to their work places.

This was not shock work, no emergency for the benefit of a moment's advantage. This was the necessity of making tomorrow be today.

All kinds of things happened in these several months. Errors and failures and almost emergencies when it was necessary to save the apparatus because of not yet understood phenomena, because a considerable part of the work was done right in the shop, and simply because of fatigue. Yet when, in the first days of December, the "Kristall" cutter moved literally by itself, still without a flame, obeying the instructions of the computer, it became clear that the work was done and hordes of curious people came to the hull machining shops.

I am holding in my palm a heavy steel square cut out by the machine (without the participation of man) under conditions where people were outside the flame zone, without participating directly in the technological process. This blank looks no different from one cut out manually or by a semiautomatic machine. It seems to me that this piece of metal includes, aside from everything else experience, hard labor and the sweat of several generations of shipbuilders.

By the way, it is even in accordance with the principles of producing such modules and production facilities. At present, tests are being made and necessary data is stored in the computer memory for all standard parts used at the plant in manufacturing ship hulls and about all the cutouts in these blanks. This is done so that the plant technologist would come to the work position, and sit down in front of the display screen. He would switch on the apparatus and begin to design the needed parts. He would call up their drawings on the screen and, pressing a button, change some dimensions, instruct the computer to place the blanks on the steel sheet most efficiently so that the automatic cutting machines in the shop would implement everything thought of by the engineer.

Last spring, this day seemed so excellent and so far away to workers of the plant imeni Zhdanov. Now, this first, although still single, machine doing such work proves that the approaching day is very near.

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INDUSTRY OFFICIAL ON PROGRESS IN SOVIET ROBOTICS PROGRAM

Moscow PRAVDA in Russian 7 Jan 84 p 2

[Article by M. Shkabardnya, USSR minister of instrument-making, automation equipment and control systems: "Robots Are Coming to the Shops"]

[Text] Robot building is a fundamentally new machine-building subsector. In our ministry it is given an independent direction. A sectorial program for the development and introduction of robot-manipulator complexes and versatile automated production facilities for 1982-1986 has been in effect since March 1982. Under this program 30,000 automatic manipulators and robotics complexes are to be developed and introduced at machine-building enterprises. Thanks to this, theoretically 45,000 people will be freed.

The program contains a broad range of interrelated problems, each of which represents an independent section. Specific goals and development deadlines are given not only for first- and second-generation robots, but also for "intellectual robots" capable of performing complex production operations with pattern recognition. A network of territorial centers for robotization and personnel training and retraining is being created. At the same time, changes are being introduced into the structure of production management.

The robotization program provides for the resolution of a number of organizational issues. For example, an institute of chief designers for robotization of 16 industrial specializations has been established. This has made it possible from the very start to arrange the development of robot models, to determine the locations of their introduction, and to arrange interaction with other sectors.

Twenty territorial centers have shown the advantage of robotization. Their main task is to assist in the maximum use of the entire region's scientific and technical potential for robotization of production. However, the results of the work at such centers are mixed. They are most effective where they find active support of party organs (in Moscow and Leningrad, in the Kiev, Lvov and other oblasts) and where problems of robotization are resolved more quickly.

We are already able to sum of some results related to the realization of this program. In 1983 alone, as an example, nearly 5,000 robots and manipulators were put into operation instead of the 3,500 under the plan.

This has an effect not only on the growth of labor productivity but also on the working conditions of enterprises, strengthening labor and manufacturing discipline including contractual relations.

By the way, in assembly the robots also proved themselves as excellent, impartial quality control inspectors for parts. In the end this has a noticeable effect on the reliability of finished products. For example, the reliability of thermo-regulators produced in the robotized section of the Orel Prompribor Association increased 1.5-fold.

In the current five-year plan the growth rates of the sector's commodity production output is above the goal. Moreover, the entire increase in production volumes in 1983 has been achieved thanks to an improvement in labor productivity--primarily due to automation and mechanization. The significance of robots up to now, perhaps, has not been that great, but we do not see the possibility of further growth rates for the coming years without implementation of the robotization program.

It must be noted that the contribution of robots to the economics of the sector could be even higher had we not ran into a number of difficulties and unresolved problems. For example, there are not enough small-size electric motors for these purposes, which are still produced in a very limited quantity. For the time being there are not enough assemblies and hydraulics components. The absence of country-wide standardization in robot designs also has an effect. Only after having solved these problems will we be able to arrange the cooperation of associated sectors and organize series production of many robot components.

We are dealing with some of these problems on our own. For example, the modular principle is the basis of most of the robots produced by our plants. Its essence is that we assemble the most multi-purpose manipulators from a specific number of components--modules. This is convenient for those who produce the robotic complexes as well as those who use them.

In spite of the much-planned nature and outlook of the program, as our experience has shown, introduction of robots without full automation of a production process, section or shop, does not yield the proper savings. Frequently this even discredits the very idea. Not individual robots, but robotized sections make it possible to develop the basis of automated production.

It is appropriate to mention here that robotization requires a different approach both to the level of technical production equipment and to the organization of continuous two- and three-shift operation. This in turn leads to a review of existing relationship of primary and ancillary shops and identification of new organizational ties between them. The immediate task here is the development of tool shops and other production preparation services.

The production base of enterprises must quickly adapt to changes in product designs. In other words, it is primarily a matter of developing flexible automated production (FAP) better suited for frequent production

change. In the meanwhile, nine model FAP's are slated to be developed and introduced under our sectorial program for subsequent circulation. The first FAP's will begin operation in instrument building in about a year.

Widespread introduction of robotic complexes and FAP's places the development of specialized service departments in the country on the agenda. After all, a FAP is not merely a complex of rearranged equipment and software, but it is also fundamentally new forms of production organization and product planning.

Now in the sphere of developing new equipment, the shortcoming has not been the lack of scientific achievements or engineering ideas but unacceptable time periods of implementing them. A gap has been noted between the growth of labor productivity in the production area and in the area of developing production technology and preparation. Production labor productivity grows much faster than engineering labor productivity. It is precisely this fact that has prompted us in our country as well as abroad to be seriously concerned with automated planning systems (APS) based on modern computer and microprocessor technology.

At the same time APS's serve as an effective means of optimizing designs, improving product reliability and producibility, and reducing the amount of metal used per unit. Among other things, this creates the necessary information and technical support for reorganizing FAP's to produce new products. So, the introduction of complete automated systems of planning shearing dies at 18 of the country's enterprises makes it possible to increase labor productivity of manufacturing engineers dozens of times over.

Taking into account the high efficiency of the APS, the ministry has formulated a scientific and technical concept and developed and approved a program based on the principle of developing an integrated planning system encompassing all phases from draft to manufacturing technology of a product. Resolution of these problems will make it possible to build automated enterprises in the near future.

Two Moscow clock plants will be the first such projects in our sector. Multilevel production control systems will operate there including automation of all basic subdivisions and key manufacturing processes. These plants will become unique proving grounds for working out and subsequent development of a broad network of similar plants.

Robotization and flexible production capacities--this is the highest stage of systems automation. It is not possible at enterprises with a low level of labor and management organization and with low discipline of production personnel. The need for rapid production renewal demands a broad technical competence from a worker and engineer and, moreover, from a manager. In our opinion, one of the main evaluation criteria in selecting managers must be their ability to grasp techniques, manufacturing methods, and methods of managerial and production automation.

12567
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USE OF ROBOTS IN ESTONIAN AUTO, MACHINE TOOL INDUSTRIES VIEWED

Tallinn RAHVA HAAL in Estonian 6 Mar 84 p 3

[Article by Oleg Jurogin, candidate in economics: "Robots Come into Factory Departments"]

[Text] In the mid-1970s only one of every twenty of the entire world's working industrial robots came from the member states of the VMN [Council for Mutual Economic Assistance (CEMA)]. At the present time over half of all the world's robots are in the countries of socialist friendship and unity. By 1990 their number will reach hundreds of thousands.

The arrival of robots in the factory departments is making it possible to begin solving on an extensive basis a task of enormous social and economic significance: elimination of the work-force shortage and the release of hundreds of thousands of laborers from work which is monotonous, difficult and sometimes even dangerous and harmful to health. For example, in our country the implementation of a robotization program drawn up for the current five-year plan is making it possible to release nearly 400,000 workers for other jobs.

A powerful developmental lever of the new special branch is cooperation among the socialist countries. Thus scientists, engineers, technicians and workers from other socialist countries enhance their qualifications and become acquainted with a new special field in the Soviet Union's scientific center for machine tool construction and in departments of the "Stankokonstruktsiya" factory. Soviet specialists in turn learn a great deal from their colleagues in the field of design and operation of valuable robots. One can mention several successful collaborations which have just been verified in practice. In the German Democratic Republic's industrial combine for textile machinery "Textima" Soviet specialists helped to create an automated line for the manufacture of polyester silk, the production of which is five times greater than with the old equipment. The line is furnished with robots for putting on and taking down bobbins of yarn, and a minicomputer controls it. The line earned the state prize of the German Democratic Republic. Soviet and Bulgarian experts designed a robot for assembly tools, a robot which successfully underwent tests in the Kharkov factory. The industrial combine "Beroe" in the Bulgarian People's Republic is starting to mass produce these robots and supply them to the Soviet Union.

But there are still several problems on the road to widespread robotization of production. The output of robots in the countries of friendship and unity satisfies at best one half of the need for them, and at the same time they are almost entirely first-generation robots, which means that they are not able to readjust themselves; they are programmed for the performance of a concrete technological process, and on the occasion of the slightest change it is necessary to alter the program or even the type of robot.

In this respect the second-generation robots, which can adapt themselves to changing production conditions, are more promising. By the mid-1980s robots with a "brain" run by microprocessors and with developed "sense organs" will prevail in the robotic world. By the year 1990, however, the principle types of robots will even possess elements of "artificial intellect." In the CEMA member states people are likewise working intensively in this direction. For instance, the second-generation robot UM-160 created by Soviet and Czechoslovakian specialists has just gone into mass production in the Czechoslovakian Socialist Republic. The robot is of world-standard quality and in 1982 received a gold metal at the Brno international fair. The plan is to supply this robot to Soviet business firms as well.

In the CEMA member states, models of third-generation automatic manipulators equipped with computers and a developed sensory system have been created. In order to speed up the introduction of mass production of "intelligent" robots the countries of friendship and unity are focusing their efforts on an increase in the manufacture of tactile, optic and auditory transducers, of converters which transform transducer signals to the electronic brain into comprehensible form, of "thinking" microprocessors and of sturdy, reliable and dexterous "hands" and "muscles" (driving gears, special electric motors and hydraulic loops) and on the expansion of their variety. Providing a strong impulse for the combining of forces in this province are the primary agreement (signed in June of 1982 at the XXXVI CEMA Congress) on multilateral cooperation in the development and widespread use of microprocessor equipment in the national economy of the CEMA member states and the intergovernmental agreement on multilateral international specialization and cooperation in the manufacture and elaboration of microelectronic element bases for computers.

Plenty of problems also have to be solved in the sphere of robot use. Up until now their chief user is machine building, primarily the auto industry, where over 60 percent of all the world's robots work. There they are used in factories for stamping, forging and mechanical processing, in casting and welding departments, and for heat treatment, painting and the application of coating materials.

Of equal topical interest is the use of automatic manipulators outside machine building for the mechanization and automation of loading, transportation and storage operations in construction, mining and metallurgy. Mobile robots and robotized transportation systems are indispensable for agriculture. It is especially difficult to imagine development of the world's bodies of water without underwater robots.

Expansion of the unification and standardization of manufactured robots and their nodes is of rather great importance both in one country as well as in all the countries of friendship and unity. Right now 128 various models of program-controlled automatic manipulators are working in the machine construction industry of the Bulgarian People's Republic, the Hungarian People's Republic, the German Democratic Republic, the Polish People's Republic, the Romanian Socialist Republic, the Soviet Union and the Czechoslovakian Socialist Republic. This means that specialized robot-production factories are needed (either in large machine-construction enterprises as in the German Democratic Republic or as independent factories; laying the foundation for them in our country is scheduled during the current five-year plan) in connection with a stepup in the manufacture of such well-polished and unified component modules.

Helping in the solution of this problem to an essential degree is the fact that in recent years in practically all the CEMA member states long-term national robotization programs have been adopted and coordinating scientific production associations (for example, Bulgaria's "Beroe," Hungary's "Tungsram" and Czechoslovakia's "Vukov") have been formed. The next step in the coordinated development of robot construction was intensification of international teamwork. The primary agreement on multilateral collaboration in the development of industrial robots and in the organization of their specialized and coordinated manufacture was signed at the XXXVI CEMA Congress. The first results of the agreement's implementation are the following: designs for robots utilized in the CEMA member countries and in capitalist states have been analyzed; a plan for integrated conception in the technical development of robot engineering has been worked out; and the requirement for robots through the year 1995 has been ascertained. The council of chief designers of industrial robots is actively at work. A planned program for the complex standardization of robot-engineering instruments is in preparation. At the XXXVI CEMA Congress, which took place in Berlin in October of 1983, emphasis was placed on the need to apply effective measures signed at the previous congress and the complete and opportune execution of agreements pertaining to the realm of robot engineering, microprocessors and microelectronics.

For this purpose one of the effective variations in concentration of efforts and instruments is, in our opinion, the formation of a scientific production association of joint robot construction for all the CEMA member states.

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